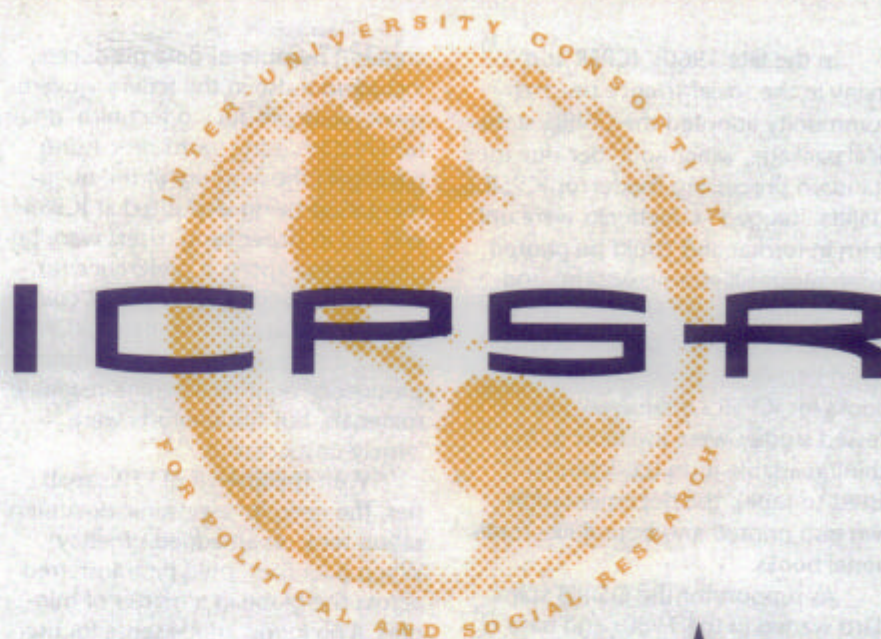




E

lectronic Documentation at ICPSR: Migrating to a Standard Format

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DIGITIZING LARGE COLLECTIONS OF LEGACY PAPER DOCUMENTS IS A PROBLEM FACED

by many institutions as they attempt to move information online for downloading and displaying via the Web. This article chronicles ICPSR's experience in transforming hardcopy technical documentation to a uniform standard — Portable Document Format (PDF).

In its more than 35-year history, the Inter-university Consortium for Political and Social Research (ICPSR) has gained a reputation for ensuring the usability, integrity, and long-term preservation of social science data resources and technical documentation. Indeed, many users look to ICPSR to provide the "Good [Data] Housekeeping Seal of Approval" for research materials as they conduct their secondary analyses. The evolution of technical documentation at ICPSR reflects this emphasis on quality and on user needs, and illustrates the types of issues that archives face as they migrate resources to alternate formats in response to shifts in technology.

Early Experience at ICPSR

ICPSR has received study documentation in varying formats over time. Early documentation primarily consisted of duplicated paper documents supplied by principal investigators. These paper documents ranged from mimeographed copies, annotated with scribbled notes in long-hand, to highly formatted, professionally printed government publications. Depending on the research potential of the studies they documented, some of the poorer quality materials were rekeyed and then distributed as electronic files. In addition, ICPSR created some documentation itself by using coding analysts to do text entry.

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In the late 1960s, ICPSR and many in the social science research community adopted the OSIRIS statistical package, which soon became the standard processing model for ICPSR. OSIRIS "tagged" codebooks were uniform in format and could be printed using most mainframe systems and the commonly used text packages of that era. During this period, users still relied heavily on print; although codebooks for ICPSR's intensively-processed studies were available in machine-readable form (codebook-listed-to-tape), the documentation was also printed and bound like traditional books.

As support for the OSIRIS standard waned in the 1980s and data producers became more adept at processing and cleaning data, ICPSR began to release more data and documentation "as is," with a minimum of processing. Ironically, while an in-

creasing number of data producers, including those in the federal government, were producing technical documentation using word processing packages, the majority of the documentation being deposited at ICPSR was still in paper form. Users were beginning to express a preference for electronic documentation that could be searched and manipulated. ICPSR pursued several strategies to obtain producers' original machine-readable materials, but these efforts were largely unsuccessful.

With the advent of FTP capabilities, the need for electronic documentation took on an added urgency. When data files could be transferred across the globe in a matter of minutes, it no longer made sense for users to wait for hardcopy codebooks to arrive in the mail. Consequently, ICPSR began to explore the use of scanning technology to convert incoming pa-

per documents to electronic form and to digitize its backlog of paper.

ICPSR began using Optical Character Recognition (OCR) scanning as a method of preparing machine-readable study documentation in the late 1980s. Approximately 10,000 pages of documentation were scanned per year using OCR, which was about 30 percent of the annual documentation intake. OCR scanning proved to be a laborious and time-consuming process, however, and it sometimes introduced errors. That generation of scanning technology often could not distinguish between the numeral "1" and a lower case "l", for instance; extensive proofreading and editing were required to produce the finished product. In addition, OCR could not handle the tables and other graphical elements common to many questionnaires, and variations in print quality were problematic as well.

This early experience demonstrated that OCR technology alone would not be adequate for conversion of ICPSR's hardcopy document holdings. As an alternative, ICPSR considered providing bit-mapped image files to users. One advantage of this method is that bit-mapping provides an exact replica of the hardcopy pages. There were disadvantages to this technology, however, in terms of storage, portability, printing, and user-friendliness. For instance, a rough calculation done in March 1995 showed that about 40 gigabytes of disk space would be needed for storage of ICPSR's codebook collection as image files, even in compressed form. Additional disk space would be necessary for working with the files before they were compressed, and for uncompressing the files. Users also needed large amounts of space for storage of the image files at their local installations. In addition, few printers at that time were equipped to print bit-image documents.

IN MAY 1995 RICHARD ROCKWELL, ICPSR EXECUTIVE DIRECTOR, ESTABLISHED A COMMITTEE TO DEVELOP A DOCUMENT TYPE DEFINITION (DTD) FOR AN INTERNATIONAL CODEBOOK STANDARD USING STANDARD GENERALIZED MARKUP LANGUAGE, OR SGML. IN 1997, THE DTD, WHICH PROVIDES A SET OF

rules for the markup of documents, was made compliant with XML (Extensible Markup Language), a subset of SGML that is more suitable for display on the Web. This project is known as the Data Documentation Initiative (DDI) and is supported in part by the same NSF grant that is contributing to ICPSR's electronic document conversion project, which is a complementary effort.

Social science codebooks marked up in XML will lend themselves to a variety of applications. Because of their structured and encoded nature, XML codebooks can be used in the production of data definition statements for SAS, SPSS, and other analysis software as well as for information discovery and retrieval. ICPSR will mark up only a portion of its electronic codebook collection, but it is hoped that as new markup tools are developed, data producers will create documentation for their studies in DDI format, making later conversion unnecessary.

The DDI project is now in the beta-test phase, which runs from March 17–August 1, 1999; thirteen test sites from around the world, chosen on the basis of proposals submitted, are currently evaluating the DTD. Testers are focusing on several different uses for the DTD and will produce reports summarizing their experiences and assessing the DTD's effectiveness and completeness at the end of the beta period. For more information on the Data Documentation Initiative, consult the URL: <http://www.icpsr.umich.edu/DDI/codebook.html>.

Portable Document Format

With this experience in mind, ICPSR's newly-formed Electronic Document Conversion (EDC) unit began to explore software that employed a combination of the OCR and bit-map technologies, and in 1995 settled on Portable Document Format (PDF). This format, developed by Adobe Systems Incorporated for use with its Acrobat software, yields a document that is searchable and manageable in size but retains the page layout and the appearance of the original. PDF documents can be enhanced with indexes, thumbnail sketches, bookmarks, and links.

PDF also provides ICPSR with a uniform standard for the archiving of documentation — a standard that is rapidly growing in popularity on the Internet. Moving to the PDF standard for all ICPSR technical documentation resolves the problem of archiving and disseminating machine-readable documentation in varying formats. With electronic documentation files received in different versions of word processing packages such as Microsoft Word or WordPerfect, users often have trouble reproducing the fonts or some other portion of a document, and conversion to ASCII text often results in a loss of information. Moreover, these word-processed documents are not suitable as archival copies since their usability in the future is questionable, given the continuing upgrades to their native formats. With the substantial international commitment to PDF demonstrated by government, industry, and academia, it is likely that an effective migration strategy for PDF documents will be widely available when a superior technology emerges.

ICPSR's "Retrofit" Project

In 1997, ICPSR received a grant from the National Science Foundation to assist in the conversion of older paper documentation to PDF form and to support the development of a documentation standard for the social sci-

ences (see sidebar). Scanning priorities were established and are continually reassessed as the project continues.

ICPSR has implemented two major methods of high-speed scanning to convert the backlog as quickly as possible. One effort makes use of the Xerox Docutech device, a high-speed copy machine used in the Duplicating Department at the Institute for Social Research (ISR). Previously, hardcopy materials were reproduced with the Docutech, but the internal image created during the copying process by the Docutech software was not usable, since it was a proprietary format. Xerox developed a solution in 1998 that successfully converts the proprietary format to a TIFF file, and with additional hardware, ISR Duplicating began storing all Docutech scans (copies) on tape. The TIFF files are easily transformed into PDF files.

In addition, a subunit of the EDC team at ICPSR was established to do nothing but scan on a constant basis, rather than scan and edit. All hardware was moved to a specific scanning area, allowing one person to operate all machines. Four scanning machines are now in operation, and the EDC unit has five permanent and two temporary employees.

Scanning Procedures at ICPSR

Typically, the data processor who is handling a study submits documentation to the EDC unit for processing to PDF. Older documents to be retrofitted are retrieved by EDC from storage facilities. Documentation can include text sections describing how a study was conducted, variable description lists, the primary codebook, record layouts, appendices, frequencies, and questionnaires. Often, there is more than one codebook documenting a study. The EDC staff reviews all documentation to see if there are basic problems, such as pages that are too dark or too light. EDC staff also compares the submission with information on the ICPSR website and with records from the

ICPSR Data Library to determine if there are missing sections or pages.

For a paper document, the EDC staff determines which software is best suited for scanning a document. They may also need to perform test runs to determine the best settings to use on the scanner so the type displays legibly. The document is scanned, and the image file that is created is processed into an editable file. In some cases, stray marks or items such as handwritten notes that the processor does not want on the final document are digitally erased. The staff reviews the editable copy of the digitized document and makes corrections as required. Some documents require extensive proofreading and editing.

With machine-readable documents, EDC again determines which software is most suitable for each part of the document. Some documents are received fully formatted. Other documents have layout, pagination, or typeface problems or contain tables or other graphical elements that must be processed to display well in the final document. Some documents are submitted in older versions of popular software or in unusual software formats and require substantial reworking.

Most documents at ICPSR are processed in the PDF "Image + Hidden Text" format, which creates a "snapshot" of the page but includes the recognized text behind the bit-map image. This means a page looks *exactly* like the original because the original image is reproduced, but the file can still be searched because the text that was recognized (through OCR) exists behind the image. By default, after a page has been scanned and converted to PDF, the software leaves as bit-map images in the PDF output file any words that it suspects may not have been recognized correctly. For many applications, this technique is the most cost-effective way of converting hardcopy documents to electronic documents. However, if error correction is desired, other software can be used to display the converted pages for editing.

After a PDF file is created, whether it was scanned from a paper original or processed from a machine-readable document, the EDC staff adds enhancements. A bookmark list is added on the left side of the file to allow easy access to the major sections of a document. By clicking on a bookmark, the user can "jump" automatically to that section of the file. Thumbnails, which are small copies of each page, are created to help users navigate a document by looking for the likeness of the page or section they are seeking. Sometimes links are created; the links enable a user to click on highlighted words on a page to access another part of the document itself, a website, or an external document.

A cover and front matter prepared by the ICPSR editors are added, and the PDF documentation is ready for a quality check before final release on the ICPSR website. A second EDC staff member quality-checks each document, clicking on every bookmark and link and checking each page to verify that no problems exist and to ensure that the document meets ICPSR standards.

Progress to Date

During fiscal year 1997-1998, ICPSR's EDC unit converted over 122,000 pages of documentation to PDF, an average of approximately 470

pages per working day. This total is nearly four times the amount scanned in the previous year. While most of the pages scanned that year were new documentation, progress is being made on the retrofit project also, with the documentation for approximately 360 studies converted since the project began. ICPSR hopes to have its backlog of over 500,000 hardcopy pages online by the year 2001.

Efforts continue to encourage data depositors to submit their original documentation in machine-readable form, but despite ICPSR's efforts in this area, about 54-60 percent of the documentation received by ICPSR still arrives in hardcopy form.

Additions to holdings

ABC News Clinton Statement #2 Poll, August 1998 — ABC News (ICPSR 2633)

ABC News Clinton Terrorism Poll, August 1998 — ABC News (ICPSR 2634)

ABC News Clinton Videotaped Testimony Poll, September 1998 — ABC News (ICPSR 2644)

ABC News "Good Morning America" Starr Report Poll #3, September 1998 — ABC News (ICPSR 2640)

ABC News Lewinsky/Starr Poll, September 1998 — ABC News (ICPSR 2636)

ABC News "Nightline" Starr Report Poll #4, September 1998 — ABC News (ICPSR 2641)

ABC News Pre-Election Poll #1, October 1998 — ABC News (ICPSR 2647)

ABC News Pre-Election Poll #2, October 1998 — ABC News (ICPSR 2648)

ABC News Pre-Election Poll #3, October 1998 — ABC News (ICPSR 2649)

ABC News Starr Report Poll #1, September 1998 — ABC News (ICPSR 2638)

ABC News Two Clintons Poll, August 1998 — ABC News (ICPSR 2635)

ABC News "World News Tonight" Starr Report Poll #5, September 1998 — ABC News (ICPSR 2642)

ABC News/Washington Post Lewinsky/Politics Poll, September 1998 — ABC News/The Washington Post (ICPSR 2643)

British General Election Study: Ethnic Minority Survey, 1997 — A. Heath and S. Saggat (ICPSR 2618)

CBS News Call-Back Poll, November 1998 — CBS News (ICPSR 2670)

Central and Eastern Eurobarometer 8: Public Opinion and the European Union, October-November 1997 — Jacques Vantomme and Louis Hersom (ICPSR 2624)

CBS News Monthly Poll #1, October 1998 — CBS News (ICPSR 2677)

CBS News Monthly Poll #2, October 1998 — CBS News (ICPSR 2662)

CBS News Monthly Poll #1, November 1998 — CBS News (ICPSR 2668)

CBS News Monthly Poll #2, November 1998 — CBS News (ICPSR 2669)

CBS News Monthly Poll #2, December 1998 — CBS News (ICPSR 2673)

CBS News Monthly Poll #4, December 1998 — CBS News (ICPSR 2675)

CBS News/New York Times Call-Back Poll, December 1998 — CBS News/The New York Times (ICPSR 2676)

CBS News/New York Times Monthly Poll #3, October 1998 — CBS News/The New York Times (ICPSR 2665)

CBS News/New York Times Monthly Poll #4, October 1998 — CBS News/The New York Times (ICPSR 2666)

CBS News/New York Times Monthly Poll #1, December 1998 — CBS News/The New York Times (ICPSR 2672)

CBS News/New York Times Monthly Poll #3, December 1998 — CBS News/The New York Times (ICPSR 2674)

CBS News/New York Times New York State Poll #2, October 1998 — CBS News/The New York Times (ICPSR 2664)

CBS News "60 Minutes" Poll, November 1998 — CBS News (ICPSR 2653)

Community Tracking Study Physician Survey, 1996–1997: [United States] — Center for Studying Health System Change (ICPSR 2597)

Cross-National Indicators of Liberal Democracy, 1950–1990 — Kenneth A. Bollen (ICPSR 2532)

Effects of Community Policing on Tasks of Street-Level Police Officers in Ohio, 1981 and 1996 — Lawrence F. Travis III and Beth A. Sanders (ICPSR 2481)

Evaluation of the Focused Offender Disposition Program in Birmingham, Phoenix, and Chicago, 1988–1992 — John R. Hepburn (ICPSR 6214)

Foreign Policy Leadership Project, 1976–1996 — Ole R. Holsti and James N. Rosenau (ICPSR 2614)

Higher Education General Information Survey (HEGIS), 1976–1977: College and University Libraries — United States Department of Education. National Center for Education Statistics (ICPSR 2116)

Higher Education General Information Survey (HEGIS), 1978–1979 Through 1979–1980: College and University Libraries — United States Department of Education. National Center for Education Statistics (ICPSR 2118)

Higher Education General Information Survey (HEGIS), 1985–1986: College and University Libraries — United States Department of Education. National Center for Education Statistics (ICPSR 2120)

Higher Education General Information Survey (HEGIS), 1967–1968: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2083)

Higher Education General Information Survey (HEGIS), 1968–1969: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2084)

Higher Education General Information Survey (HEGIS), 1970–1971: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2138)

Higher Education General Information Survey (HEGIS), 1979–1980: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2147)

Higher Education General Information Survey (HEGIS), 1980–1981: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2148)

Higher Education General Information Survey (HEGIS), 1983–1984: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2157)

Higher Education General Information Survey (HEGIS), 1984–1985: Earned Degrees — United States Department of Education. National Center for Education Statistics (ICPSR 2158)

Higher Education General Information Survey (HEGIS), 1971–1972: Salaries, Tenure, and Fringe Benefits of Full-Time Faculty — United States Department of Education. National Center for Education Statistics (ICPSR 2191)

Higher Education General Information Survey (HEGIS), 1972–1973: Salaries, Tenure, and Fringe Benefits of Full-Time Faculty — United States Department of Education. National Center for Education Statistics (ICPSR 2192)

Higher Education General Information Survey (HEGIS), 1975–1976: Salaries, Tenure, and Fringe Benefits of Full-Time Faculty — United States Department of Education. National Center for Education Statistics (ICPSR 2190)

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- Comparative Data
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- Digital Government Initiative
- Instructional Uses of ICPSR Data
- New Methodological Approaches

All sessions for the 1999 meeting will be held in the Michigan Union on the University of Michigan campus; Saturday night's banquet dinner will take place at the Michigan League. A reception is planned for Friday night at ICPSR's new location, 311 Maynard Street.

An online registration form, along with other information about the meeting, will be available soon on the ICPSR Website at <http://www.icpsr.umich.edu>.

Higher Education General Information Survey (HEGIS), 1978–1979: Salaries, Tenure, and Fringe Benefits of Full-Time Faculty — United States Department of Education. National Center for Education Statistics (ICPSR 2197)

Higher Education General Information Survey (HEGIS), 1979–1980: Salaries, Tenure, and Fringe Benefits of Full-Time Faculty — United States Department of Education. National Center for Education Statistics (ICPSR 2198)

Longitudinal Study of Criminal Career Patterns of Former California Youth Authority Wards, 1965–1984 — Rudy A. Haapanen (ICPSR 2478)

National Health Interview Survey, 1994: Family Resources Income and Assets Supplement — United States Department of Health and Human Services. National Center for Health Statistics (ICPSR 2656)

National Health Interview Survey, 1992: Family Resources Supplement — United States Department of Health and Human Services. National Center for Health Statistics (ICPSR 2655)

National Hospital Discharge Survey, 1996 — United States Department of Health and Human Services. National Center for Health Statistics (ICPSR 2620)

New York Times New York State Poll #1, October 1998 — *The New York Times* (ICPSR 2667)

Public Support for Rehabilitation in Ohio, 1996 — Brandon K. Applegate (ICPSR 2543)

Social Networks and Television Manager Turnover, 1997: [United States] — Michael Davern and David S. Hachen, Jr. (ICPSR 2650)

Status of Older Persons in Economic Commission for Europe (ECE) Countries, Census Microdata Samples: Latvia, 1989 — United Nations Economic Commission for Europe. Population Activities Unit (ICPSR 2572)

WABC-TV/New York Daily News New York Statewide Poll, October 1998 — WABC-TV/New York Daily News (ICPSR 2645)

Washington Post Starr Report Poll, September 1998 — *The Washington Post* (ICPSR 2637)

Washington Post Vote Poll, October 1998 — *The Washington Post* (ICPSR 2646)

R evisions/Updates

CBS News/New York Times Monthly Poll #2 and Call-Back, October 1995 — CBS News/*The New York Times* (ICPSR 6701)

Criminal Careers of Juveniles in New York City, 1977–1983 — Laura A. Winterfield (ICPSR 9986)

Higher Education General Information Survey (HEGIS), 1982: Fall Enrollment — United States Department of Education. National Center for Education Statistics (ICPSR 8292)

Higher Education General Information Survey (HEGIS), 1983: Fall Enrollment — United States Department of Education. National Center for Education Statistics (ICPSR 8397)

National Crime Surveys: Victim Risk Supplement, 1983 — United States Department of Justice. Bureau of Justice Statistics (ICPSR 8316)

National Household Survey on Drug Abuse, 1990 — United States Department of Health and Human Services. National Institute on Drug Abuse (ICPSR 9833)

National Indigent Criminal Defense Survey, 1982: [United States] — Abt Associates, Inc. (ICPSR 8417)

National Longitudinal Study of the Class of 1972 — United States Department of Education. Center for Education Statistics (ICPSR 8085)

National Survey of Access to Health Care, 1986 — Howard E. Freeman (ICPSR 8981)

National Survey of Access to Medical Care, 1982 — Ronald M. Andersen and Lu Ann Aday (ICPSR 8244)

Techniques for Assessing the Accuracy of Recidivism Prediction Scales, 1960–1980: [Miami, Albuquerque, New York City, Alameda and Los Angeles Counties, and the State of California] — Jacqueline Cohen, Sherwood Zimmerman, and Stephen King (ICPSR 9988)

P ublication- Related Archive

Price Stability and Financial Stability: The Historical Record — Michael D. Bordo and David C. Wheelock (ICPSR 1191)

C D-ROMs

Data on Crime and Community — Sponsored by National Institute of Justice (ICPSR 2434) [CD0024]

Summer Program, 1999

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Advanced Analysis of Variance
Quantitative Analysis of Crime and Criminal Justice
Advanced Maximum Likelihood Estimation
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Categorical Data Analysis I (June 7–11)
Categorical Data Analysis II (June 14–18)
Criminal Justice Data: Women and Crime (June 21–25)
Hierarchical Linear Models (July 12–16)
Mental Health Research (July 12–16)
LISREL Models: Introduction (July 26–30)
LISREL Models: Intermediate (August 2–6)
Social Network Analysis (June 28–July 2)
Providing Social Science Data Services (August 2–6)
Latent Growth Curve Analysis (May 21–23: Chapel Hill, NC)
Selection Bias in Aging Studies (June 14–18)

*ADVANCED TOPICS

Resampling Techniques: Jackknife and Bootstrap
Statistical Graphics for Univariate and Bivariate Data
Missing Data Analysis
Data Visualization and Interactive Cluster Analysis
Bayesian Modeling
Nonparametric Regression
Ecological Inference

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ICPSR BULLETIN SUMMER 1999 — VOL. XIX, NO. 4

The Inter-university Consortium for Political and Social Research (ICPSR), located at the Institute for Social Research in Ann Arbor, is the world's largest repository of computer-readable social science data. For over 35 years, the Consortium has served the social science community by acquiring, processing, and distributing data collections on a broad range of topics. Researchers at the Consortium's member institutions may obtain any of these data collections at no charge; researchers at nonmember institutions may also use the data, after paying an access fee. To find out more about ICPSR's holdings or about a specific data collection, access the ICPSR Website at the URL: <http://www.icpsr.umich.edu>.

The *ICPSR Bulletin* is published four times during each academic year to inform Official Representatives at the member campuses, ICPSR Council members, and other interested scholars of activities occurring at ICPSR and at other member institutions and to list the data collections most recently released or updated by ICPSR. For subscription information, contact the Editor.

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